Is it time to refresh the heart team? New paradigms for shared decision making

Julian Yeoh , Philip MacCarthy

INTRODUCTION
Traditionally composed of an interventional cardiologist, non-invasive cardiologist and a cardiac surgeon, the ‘heart team’ (HT), involves a multidisciplinary approach to decision making for cardiovascular patients. Following publication of the SYNTAX trial in 2009, this approach for coronary revascularisation has gained popularity. The concept has been incorporated into the European Society of Cardiology/European Association of Cardiothoracic Surgery (ESC/EACTS) and the American College of Cardiology/American Heart Association/Society for Cardiovascular Angiography and Interventions (ACC/AHA/SCAI) Guidelines for Percutaneous Coronary Intervention as a Class I, Evidence Level C, recommendation, particularly for those with left main stem and complex coronary artery disease (CAD). It has now been widely adopted and expanded to include patients with aortic stenosis (AS) being considered for transcatheter aortic valve implantation (TAVI), many of whom have complex medical comorbidities. However, this HT concept continues to evolve beyond left main stem/triple vessel disease revascularisation and high-risk elderly patients with AS. It now has expanded to patients with CAD at high risk due to comorbidities/chronic coronary occlusions and valvular intervention beyond AS including ever-increasing subspecialty involvement. This article discusses the history and evolution of the HT and the paradigm shifts that have occurred along the way, analysing the advantages and challenges of such shared decision making. We debate the future direction of the HT and the evolution necessary to meet the demands of rapidly changing medical practice.

THE ORIGINS OF THE HT
In 2009, the SYNTAX trial (percutaneous coronary intervention vs coronary-artery bypass grafting for severe CAD) demonstrated that CABG was the standard of care for patients with three-vessel or left main CAD. This led to the adoption of SYNTAX scores where outcomes (both surgical and percutaneous) were predicted by anatomical coronary artery characteristics and patient comorbidities. A specially formed HT gave an opinion about the risk/benefit of separate therapeutic options. There was precedent in other specialities, where for example, a multidisciplinary approach has been a key part in the management of patients with cancer for several years.

The HT was thought to be able to: (1) more objectively interpret the available diagnostic information, (2) implement guideline-directed therapy, (3) consider and involve local expertise and (4) through shared decision making, take into account patient preferences and provide a more uniform decision-making process. The goal of the HT was therefore to offer a balanced and contemporary approach to patient care derived from different medical stakeholders including those in both cardiac surgery and interventional cardiology.

Although the HT appeared to be an intuitive, reasonable and thorough approach, there was no supportive data for its use. Indeed, it is remarkable that such a fundamental process should be accepted and even incorporated into international guidelines with such little data to support it. Studies on the outcomes of the HT approach have only recently demonstrated benefits in terms of feasibility and timeliness to decision and subsequent treatment. Lack of uniformity has been notable with initial studies demonstrating that up to 24% of decisions changed when patients were rediscussed at a second HT. More recent contemporary studies have suggested that the HT decision making has become somewhat more reproducible, with slightly better alignment to clinical guidelines.

THE HT IN PATIENTS CONSIDERED FOR TAVI
The HT developed early in the evolution of TAVI, which entered the clinical mainstream in Europe and North America from 2007. Multidisciplinary discussions were thought to be vital to patient selection, particularly when deciding on the most appropriate treatment modality; comparing the novel transcatheter techniques to conventional surgical aortic valve replacement (sAVR). This was in part driven by sensitivities towards untrusted, novel and ‘disruptive’ technologies that were encroaching on traditionally surgical territory. The cardiothoracic surgeons were always the ‘gatekeepers’ of treatments for AS, and the new TAVI HT was only deemed quorate when it included the relevant ‘stakeholders’: cardiologists, cardiac
surgeons, imaging physicians, anaesthetists and geriatricians.16

This original, simple idea has had to function throughout what has been a revolution in the management of valvular heart disease, with both an expanse of novel therapeutic options and the available evidence (see figure 1) With increasing evidence for TAVI for high-risk, intermediate risk and now low-risk patients, the original basic TAVI HT has been accepted and often not questioned or challenged by clinicians involved in the care of such patients.17 TAVI HT meetings occur in some form in every institution performing TAVI in the world, although with great heterogeneity in their form. During this time it has become widely accepted that decisions regarding TAVI, which require a risk/benefit analysis for the procedure compared with sAVR and/or medical therapy, should be made by the HT that can provide expertise on the evidence base allied with high volume clinical experience. It is now obvious to most clinicians that this cannot be provided by one individual to the same level.

The early TAVI HT struggled to find its feet. Patient selection for TAVI often depended heavily on risk scores, derived from algorithms designed for conventional open heart surgery (Society of Thoracic Surgeons and EuroScore II), and it took several years to realise that this was flawed and oversimplified.18-20 Factors such as frailty, anatomical idiosyncrasies (eg, porcelain aorta and ‘hostile’ chest), previous cardiac surgery and liver disease were grossly under-represented by these simple scores yet were extremely important to decision making and quality case selection.21-23 Despite its limitations, the TAVI HT was becoming more prominent and widespread because of a massive increase in the number of TAVI cases worldwide with simplification of the TAVI procedure and a rapidly evolving evidence base that continually changed the risk–benefit relationship between TAVI and sAVR. The science of imaging was evolving in parallel with this and the introduction of three-dimensional/multimodality imaging (particularly with gated cardiac CT) led to a significant growth in the importance of highly specialised imaging physician input to HT decisions.4-23

Guidelines were changed to keep pace of these developments, with the current AHA/ACC guidelines giving a Class I recommendation (Level C evidence) that patients with AS should be evaluated by a ‘multidisciplinary valve HT at a centre of expertise in valvular heart intervention’,26 but detail about the form of the HT was neither specified nor mandated. The ESC/EACTS guidelines for the

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**Table 1** The pros and cons of heart team decision making

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Challenges and disadvantages</th>
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<tbody>
<tr>
<td>Unbiased balanced decision making.</td>
<td>Risk of bias depending on team member attendance.</td>
</tr>
<tr>
<td>Broader interpretation of the available diagnostic information.</td>
<td>Lack of consistent terms of reference.</td>
</tr>
<tr>
<td>Ability to implement evidence-based, guideline-directed therapy.</td>
<td>Time delay from referral to treatment decision.</td>
</tr>
<tr>
<td>Clear documentation and improved governance.</td>
<td>Lack of administrative support.</td>
</tr>
<tr>
<td>Better allocation of limited resources.</td>
<td>Lack of consistency worldwide.</td>
</tr>
<tr>
<td>Consideration of novel therapies.</td>
<td>Lack of supportive evidence for the benefit.</td>
</tr>
<tr>
<td></td>
<td>Lack of familiarity of the patient at the centre of discussion.</td>
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management of valvular heart disease also gave a Class I recommendation (Level C evidence) for this aspect of patient management.27

ADVANTAGES OF THE HT
There have been several advantages of the HT in the era of TAVI (see table 1), Balanced discussions usually lead to sensible, evidence-based decisions in selecting patients for sAVR versus TAVI. More detailed analysis of the imaging allows selection of the most appropriate TAVI device and procedural approach with the least risk for complications. A unified process of reviewing patients referred to the unit has the added benefit of formal documentation of decisions, particularly where electronic recording has become the norm. This approach improves clinical governance and also offers the opportunity for data collection and the development of a strong research base.

CHALLENGES AND DISADVANTAGES OF THE HT
There are, however, challenges and disadvantages of the HT approach (see table 1).

Cultural changes
Encouraging autonomous clinicians to defer their decisions to achieve consensus in an HT has been a major barrier to ‘buy-in’ across the world. Most senior specialists feel that they know the best approach for their patients, and they are usually correct. However, while this is true for the more straightforward patient, there are an increasing number of complex patients who require further multidisciplinary discussion to achieve a balanced consensus and to avoid bias to one’s own subspecialty. This was recognised as a problem in the very early HTs during the SYNTAX trial.

Variable terms of reference
There is significant variation in the terms of reference for HTs. In many units, only a proportion of patients are subjected to HT discussion and the reasons that some patients bypass HT discussion is often obscure. The internal rules about which patients should be discussed and who does not need discussion are ill-defined, with patients often bypassing the HT because of the tradition of named, personal referral to a specialist. It is therefore often deemed voluntary that specialists ‘bring their cases’ to the HT, and these are usually the patients that they are having difficulty making a decision about. This creates bias in the patient load discussed at the HT meetings.

Time inefficiencies
HT discussions are time-consuming, often because they are not well prepared, and this is a particular problem when there is inadequate administrative support. A counterargument would be that a well-prepared HT meeting that generates decision letters and management plans in real time would be significantly more time efficient than an ad hoc process. However, there is no doubt that HT meetings need to be agile enough not to delay treatment—a problem particularly seen with inpatients.28

Inadequate resources
Unfortunately, HT meetings are under-resourced, and it is only recently that HT administrative support has been acknowledged to be essential.29 The role of administrative support goes beyond taking minutes and recording decisions on each case and should cover the entire process of patient management from referral to follow-up and input of data. Administrative support should therefore include:

1. Creating a central reception point for referrals.
2. Preparing case notes imaging (which is often performed elsewhere and can be very time-consuming to source).
3. Creating a communication (by letter or email) to the relevant clinicians and the patient, recording the outcome.
4. Scheduling the procedure and follow-up.
5. Entering all data on a local/national database.

<table>
<thead>
<tr>
<th>Clinical considerations</th>
<th>Anatomical considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young age with low surgical risk.</td>
<td>Large annulus (outside the range for current devices).</td>
</tr>
<tr>
<td>Possible infective endocarditis.</td>
<td>High-risk anatomy for coronary obstruction.</td>
</tr>
<tr>
<td>Concomitant severe mitral valve disease.</td>
<td>Congenitally bicuspid anatomy.</td>
</tr>
<tr>
<td>Concomitant severe tricuspid regurgitation.</td>
<td>Unfavourable access for trans-femoral approach.</td>
</tr>
</tbody>
</table>

sAVR, surgical aortic valve replacement; TAVI, transcatheter aortic valve implantation.
Lack of consistency across the country/world
The lack of uniform terms of reference makes HT policy inconsistent between countries. Given that there are very few guidelines for exactly what constitutes a good HT, individual institutions tend to create their own standards and hence some patients will be subject to excellent, functional and timely HT discussion to inform their management and others may not.

Lack of evidence that HT decision making leads to better patient outcomes
Although intuitive in the management of patients with valvular heart disease, there is little evidence to support HT adoption. In fact there is recognition that there is no randomised trial to support such an approach; rather studies describe a multidisciplinary programme without an appropriate comparator.30 One of the few studies investigating a specific HT intervention compared a ‘joint clinic’ review approach (surgeons and interventionalist) to a ‘single doctor clinic’ and demonstrated faster decision times and a greater ‘turn-down rate’ for TAVI with the ‘joint clinic’ model.31 This lack of evidence for the benefit of the HT has been highlighted, and a call for evidence was suggested in the literature.8 Clear definitions and shared metrics to advance our understanding of an optimal HT approach in this setting is clearly necessary in order to evaluate HTs in the future.8

Lack of a quorate meeting
Given the time demands of the subspecialty physicians in hospital practice, HT meetings are not always quorate, and attendance is variable. This may impact on the ability of the panel to recommend a particular treatment in a balanced way, but in the absence of clear terms of reference, meetings and decisions often proceed anyway. The HT dynamic is also influenced by more subtle phenomena with more dominant members of the team influencing outcomes—a situation where the ‘loudest voice’ dominates.32

Lack of familiarity with the patient
One valid criticism of HT decision making has been that many of those in the HT giving their opinion about life-changing therapies for a patient have never seen/reviewed that individual, which in some regards could be seen as an aberration from good medical practice. The role of the clinical nurse specialist, where available, has become particularly relevant in this regard, because such nursing staff often spend more time speaking to the patient and their relatives and therefore have better insights into how symptoms affect quality of life and the ease of potential discharge and rehabilitation after any intervention. This issue also raises the fundamental question of whether the patient should attend a HT meeting—the patient being the most important member of the HT. This is not a new idea—patients were traditionally brought to see groups of doctors in historical Grand Rounds (see figure 2).

Patient involvement in decision making is fundamental, and increasingly, patients and their relatives are keen to be involved in more detailed discussions about their management. In an era of ever-growing access to online media, they have available to them specific information about options for the treatment of valvular heart conditions. The HT must take this into consideration and manage these expectations.

LIMITATIONS OF THE HT IN ITS CURRENT FORMAT
There have therefore been a number of paradigm shifts since the inception of the TAVI HT. One of the most fundamental changes has been the concept that all patients with AS should be considered for sAVR in the first instance and for those not suitable, consideration given to TAVI. The situation has now reversed with a move towards considering all patients for TAVI in the first instance and then considering them for sAVR if the anatomical features are not suitable. Thus, the HT should now weigh the clinical and anatomical characteristics to
identify the best treatment option for individual patients with transfemoral TAVI replacing sAVR as the default therapy, particularly for intermediate/higher risk patients. Each type of intervention for AS has its strengths and weaknesses, and tailoring therapy demands a knowledge of the patient features better suited to TAVI and those better suited to sAVR. For example, despite the success of TAVI, some specific clinical factors may favour sAVR. In addition, patients would also move towards sAVR with anatomical features adverse for TAVI. These issues are summarised in table 2.

Another paradigm shift has been the scope of the discussions in the TAVI HT. As transcatheter options for the treatment of valve disease have improved and increased, more complex patients are being considered for intervention, patients that were formerly consigned to medical management. This phenomenon has tapped into the unmet need of patients previously thought to have no option but also increases the complexity of the discussion. Such patients often have multiple valve lesions, non-cardiac comorbidities and a level of frailty that makes conventional open-heart surgery challenging and often impossible. A proportion of patients in this new, expansive group will not be appropriate for any form of intervention, and palliative care involvement may be appropriate. The conventional TAVI HT will struggle to cope with these new layers of complexity.

The exciting developments in transcatheter mitral and tricuspid intervention (see figure 3) have had a number of impacts on the TAVI HT:

1. Complex cases take longer to discuss, leaving less time for more straightforward TAVI patients.
2. The range of options in mitral and tricuspid transcatheter therapy has greatly evolved—often involving devices that work in different ways and need to be tailored to very specific patient/valvular anatomies, increasing the need for advanced imaging analysis.
3. Many of these newer mitral and tricuspid devices are early in their development, often only being available in a clinical trial/registry or on a compassionate basis. Offering such therapies mandates involvement of research nurse specialists and industry sponsors to screen patients for their suitability.
4. The availability of multiple transcatheter options has introduced the concept of phased (stepwise) percutaneous treatment for previously untreatable patients (eg, treating AS with TAVI and going on to treat mitral regurgitation (MR) with mitral valve technology), which increases the complexity and mandates numerous discussions of the same patient at several HT meetings.
5. As a ‘victim of its own success’, the HT meetings are often served complex valve patients from colleagues not present, again taking a large component of the HT bandwidth in order to understand the problems.

**THE ‘VALVE’ HT BEYOND TAVI**

With this expansion ‘beyond the aortic valve’, it has become evident that the conventional TAVI HT is inadequate and no longer fit for purpose. The nature of the TAVI versus sAVR debate changed, and the remit of the HT has expanded hugely. The HT by incorporation of a standard referral and treatment pathway, such as that depicted in figure 4, must therefore be refreshed with the following principles:

1. The HT is more than a meeting; it has become a system of specialist care and the individuals who contribute to it.
2. Patients with AS considered for intervention should be assessed for their suitability for TAVI in the knowledge that it is the clinical and an-

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**Table 3** Preferred subspeciality personnel attendance at various HT multidisciplinary meetings

<table>
<thead>
<tr>
<th>Condition</th>
<th>Non-invasive cardiologist/heart failure specialist</th>
<th>Interventional cardiologist</th>
<th>Cardiac surgeon</th>
<th>CT imaging cardiologist/radiologist</th>
<th>Echo imaging cardiologist</th>
<th>Anaesthetics</th>
<th>Vascular surgeon/interventional radiologist</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic stenosis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Care of the elderly physician</td>
</tr>
<tr>
<td>Mitral/tricuspid valve disease</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous and other valve disease</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Coronary and other cardiac intervention</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Complex high-risk operator</td>
</tr>
<tr>
<td>(aorta only/pericardial)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
atomical characteristics rather than just the surgical risk estimation that drives the choice between transcatheter and surgical intervention.
3. Mitral and tricuspid valve disease could be considered in a separate meeting with a different emphasis, complex imaging interpreted by specialists and additional involvement of heart failure physicians where necessary.
4. Device therapy for mitral and tricuspid disease is offered when surgical valve repair/replacement is not feasible. Newer devices for these valves often have a limited supportive literature and will involve research studies/registries to further their evidence base.
5. The infrastructure and terms of reference need to be defined and standardised with linkage to the referral network. Involvement of referring colleagues is fundamental for quality and communication—the HT should be at the centre of the network of care for patients with valve disease.
6. The patient must be at the centre of every HT and preferably seen and assessed by the key decision makers within the HT.

Should the patient attend the HT?
The concept of a ‘Joint clinic’ has emerged where an interventional cardiologist, cardiac anaesthetists and cardiothoracic surgeon (and other specialists as appropriate) review patients jointly. This helps prevent delays in progressing through a treatment pathway but also allows a unified decision during an initial assessment on the need for intervention and candidacy for such (as opposed to medical management). Having echocardiography and CT services available at the time of this initial review will also fast-track discussion and allow a possible ‘one-stop’ approach, minimising the number of trips to hospital the patient has to make. Including the patient and the patient’s families in the process with the use of decision aids (such as patient information sheets/resources) has also been shown to allow awareness of options and enhance patient-centred outcomes.

TRAINING A STRUCTURAL HEART SPECIALIST
Another key aspect of the modern valve HT is training, which will need to reach beyond the management of AS to all types of structural heart conditions. Training for a structural heart physician will involve refining clinical decision making and the development of procedural skills, proficiency in imaging modalities, management of procedural complications and cardiac surgical procedural familiarity. Some countries are now training structural cardiologists as a hybrid of the cardiac surgeon and interventional cardiologist—the so-called catheter or wire surgeon. This paradigm shift will hopefully allow the structural heart physicians to consider a disease-based approach rather than a procedural approach, with less bias to one particular ‘camp’. The modern HT should be at the centre of this change.

WHAT DOES A PERFECT VALVE HT LOOK LIKE?
The perfect valve HT (VHT) is more than a team or a meeting but is a system of care that efficiently navigates the patient towards tailored, appropriate, timely and contemporary intervention, exposing them to state-of-the-art expertise both in decision making and execution of procedures. Figure 3 identifies the evolving composition of the VHT in comparison to its traditional make-up. This VHT and system of care will need:
1. Standardised, consistent terms of reference mandating minimum standards for meetings, administrative support and audit.
2. Subdivision of meetings to concentrate appropriate expertise efficiently, perhaps into:
   a. Aortic stenosis (TAVI vs sAVR) and procedural planning.
   b. Mitral/tricuspid valve disease.
   c. Miscellaneous valve issues referred from other specialties.
   d. Coronary and other cardiac intervention (see table 3).
3. A joint HT clinic, where the HT can meet and assess patients simultaneously.
4. The ability to use a secure and confidential virtual platform for:
   a. Patient review as part of a virtual video clinic to expedite triage.

Key messages
► The concept of the heart team (HT) is now widely accepted in the mainstream care of cardiovascular patients.
► There are clear advantages of the HT including providing unbiased, balanced decision making, but the evidence that they improve outcomes is lacking.
► Several challenges and disadvantages exist, and these need to be acknowledged and addressed to design the modern ’valve HT’ of the future.
► A valve HT should be seen as more than just a multidisciplinary meeting but rather a system of care and specialists to care for patients with complex valvular heart disease, from referral to treatment to follow-up.

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CONCLUSION
The concept of the HT is mature but because of the revolution in the field of valvular heart disease, is now outdated and needs to be refreshed. Clinical decisions no longer revolve around choosing between TAVI and sAVR but require the management of complex patients, tailoring therapy to a wide range of techniques and devices across all heart valves. The goal is personalised care that should involve the patient and their families, and the HT of the future should be agile enough to allow decision making to develop in parallel with advances in the field.

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